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RESEARCH DEPARTMENT

THE STANDARD TELEPHONES AND CABLES TYPE 4126 MICROPHONE

Technological Report No. L-067/1
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for Head of Research Department

May 1

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THE STANDARD TELEPHONES AND CABLES TYPE 4126 MICROPHONE

SUMMARY

This report describes tests on five samples of the type 4126 capacitor microphone made by Standard Telephone and Cables Ltd. It is a miniature version of the type 4108 instrument but employs a field-effect transistor instead of a valve in the head amplifier. Power is supplied by means of long-life batteries in a small case which may be situated up to 100 ft (30 m) from the microphone.

The frequency characteristics show a serious falling off at the upper end of the range; the degree of interference from wind and from magnetic fields is low. There is a considerable difference in sensitivity and bass response between samples.

1. INTRODUCTION

Standard Telephones and Cables Ltd. have produced a new capacitor microphone type 4126. It is a miniature version of the type 4108,* and uses the same capsule, but it employs a field-effect transistor instead of a valve in the head amplifier and it is claimed that this results in a very low noise level. Output impedances of 30 or 300 ohms are available, the only difference lying in the turns ratio of the output transformer which is housed in the battery case.

Two models have been produced, the casing of the first being cylindrical and that of the second more streamlined. In each design the capsule is surrounded by a fine wire gauze which forms part of the case and affords some protection against interference from wind. For more severe conditions a windshield is provided which is made of stainless steel gauze and is 2 in. (51 mm) in diameter.

Five specimens have been tested so some estimate is possible of the production spread of the various characteristics.

2. DESCRIPTION

Fig. 1 gives an external view and the dimensions of the two designs and of the battery case; the small size will be noted. This is the smallest capacitor microphone so far tested. Power is supplied by batteries, which may be situated up to 100 ft (30 m) from the microphone; alternatively a mains unit may be used which will supply up to

* An earlier type, of which only a small number were on service trial in 1964.

three microphones simultaneously. The life claimed for the low tension and high tension batteries is 300 hours and 3 years respectively.

The capsule has a metallised plastic diaphragm and a sintered porous ceramic back plate. To avoid the ingress of moisture between the diaphragm and back plate the latter is enclosed in a slack plastic diaphragm. Unfortunately this feature can lead to asymmetry in the directional properties of the microphone; this point is referred to later in Section 3.2 on frequency characteristics.

Weight: The weight of the microphone without cable is 1½ oz (50 g. approximately).

Price: The price of the microphone is £50 to which must be added £15 for the battery supply unit or £19.10s.0d. for the mains unit, making a total of either £65 or £69.10s.0d. for a complete system.

3. PERFORMANCE

3.1. Method of Measurement

The frequency characteristics of the microphones above 200 c/s were measured by comparison with a pressure standard in a free-field room, and at frequencies below 200 c/s in a travelling wave duct by comparison with the same standard. Generally the accuracy of comparison is $\pm \frac{1}{2}$ dB; errors of ± 1 dB are, however, possible in the measurements for sound incident at angles greater than 90°.

3.2. Frequency Characteristics

Figs. 2 and 3 show the open-circuit frequency

characteristics of two of the microphones for sound incident on the axis and at various angles to it. Fig. 4 shows the axial response of the other three, the curves being arbitrarily made to coincide at 1 kc/s; the shape of the case is not thought to have any effect on the frequency characteristic. It will be observed that there is an appreciable loss in response at high frequencies; the units are inferior in this respect to the later specimens of the type 4108. The frequency characteristic for sound incident in the plane at 90° to the axis varies with the direction in that plane. This asymmetry, which is illustrated in Figs. 2 and 3 by the curves designated +90° and -90°, is thought by the makers to be due to the slack plastic diaphragm, which, as mentioned earlier, is situated at the back of the capsule. The spread in axial response for the five specimens is shown in Fig. 5 and it will be noted that the variation at low frequencies is excessive. Fig. 6 shows the characteristics claimed by the makers.

3.3. Impedance

The modulus of the impedance of two of the microphones is shown in Figs. 7 and 8. It will be seen that in each case the impedance at the base rises to about 50% above the mid-band value; this change is unlikely to have a serious effect on the frequency characteristics of other microphones connected in parallel. Fig. 9 indicates the amount by which the open-circuit response will be changed if the microphones are operated into resistive loads equal to the nominal impedance.

3.4. Sensitivity

As with all capacitor microphones, the signal generated in the capsule is proportional to the polarizing voltage; in addition, however, the gain of the transistor varies considerably with the supply voltage, so that the overall sensitivity depends very much on the state of the batteries. The variation in sensitivity with L.T. voltage was measured on open circuit for one specimen and the results are shown in Fig. 10.

With new batteries the mid-band sensitivities of the five samples tested, referred to a 300 ohm output impedance, vary from -64 dB to -77 dB with reference to 1 volt/dyne/cm², compared with the maker's figure of -74 dB. This range of sensitivities is very wide and would be inconvenient in service. Comparable microphones in current use have a sensitivity of about -58 dB with reference to 1 volt/dyne/cm².

4. NOISE

4.1. Internally Generated Noise

The internally generated noise appearing at the output terminals of the microphone is a combination of transistor noise and of thermal agitation in the resistive component of the gate circuit impedance.

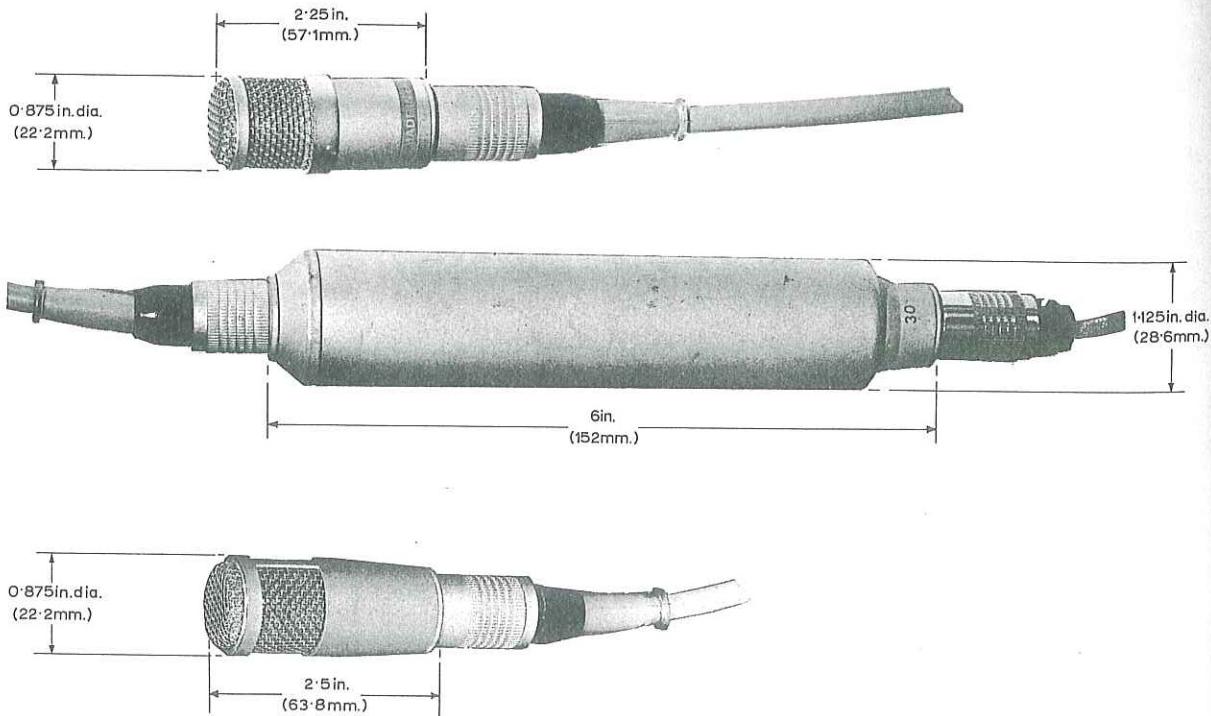
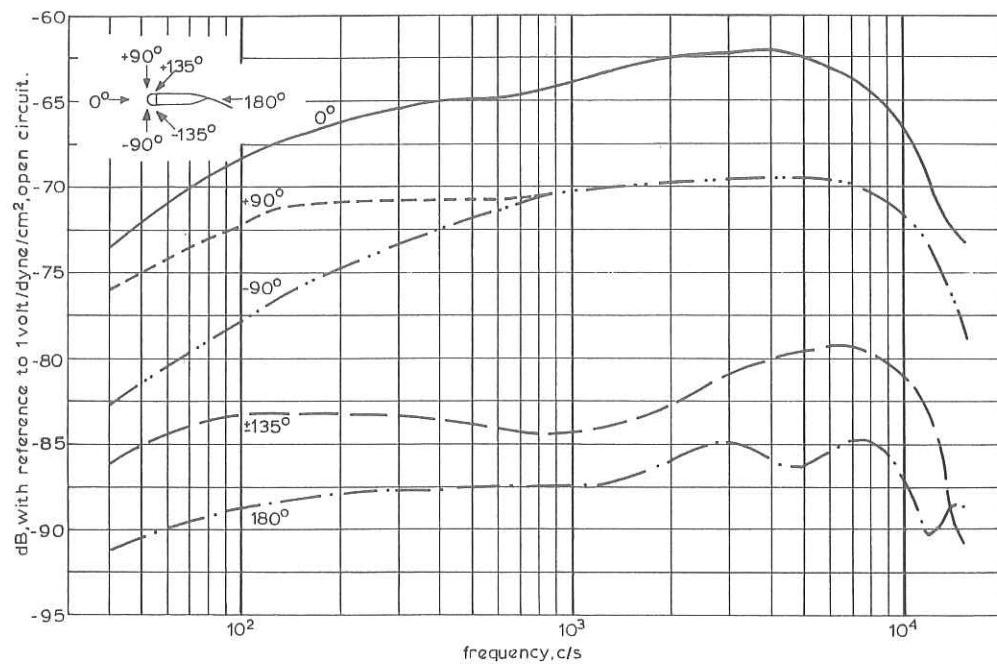
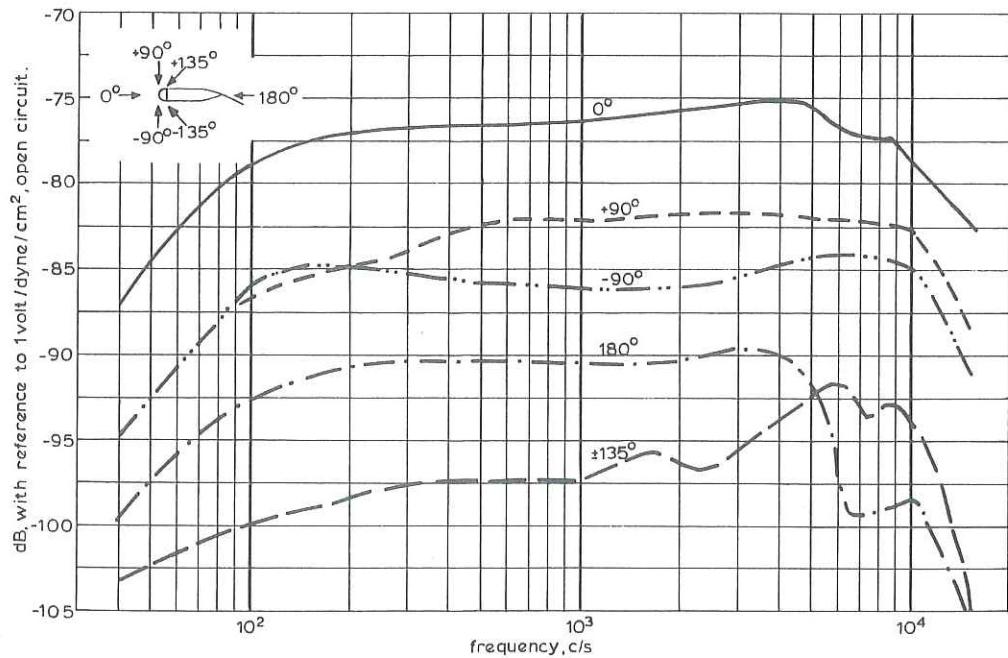


Fig. 1 - External appearance and dimensions of S.T. and C. microphone type 4126



*Fig. 2 - Frequency characteristics of S.T. and C. microphone type 4126, specimen 1.
Nominal impedance : 300 ohms*



*Fig. 3 - Frequency characteristics of S.T. and C. microphone type 4126, specimen 2.
Nominal impedance : 30 ohms*

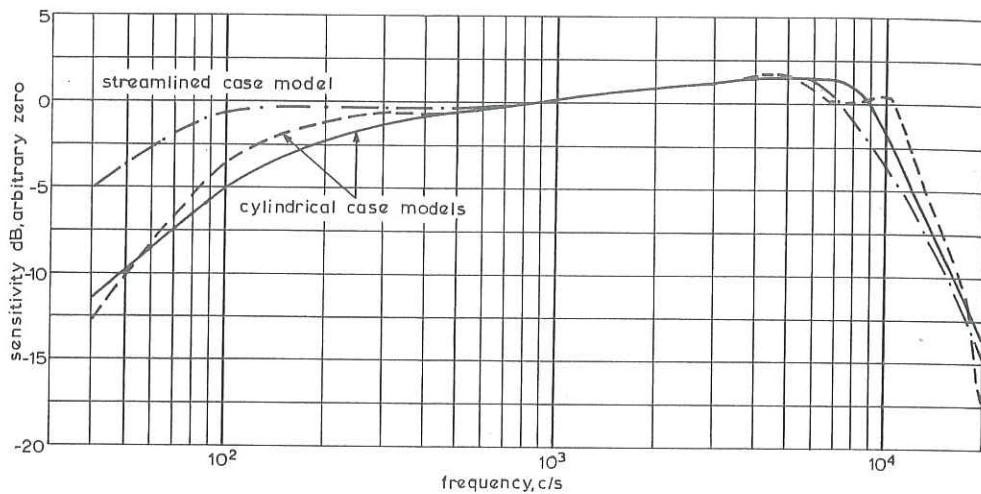


Fig. 4 - Axial frequency characteristics of S.T. and C. microphone type 4126, specimens 3, 4 and 5

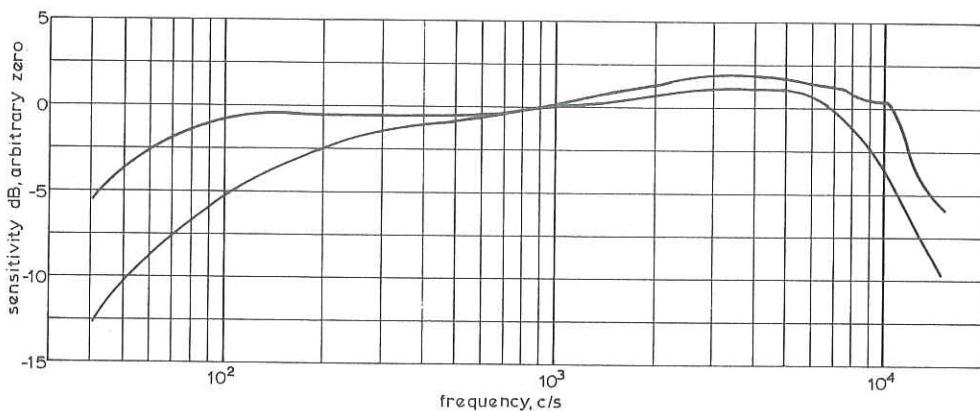


Fig. 5 - Spread in axial frequency characteristics of S.T. and C. microphone type 4126, specimens 1 to 5

The open-circuit noise when weighted by an aural sensitivity network type ASN/3 is -116 dB and -125 dB with reference to 1 volt for specimen 1 (300 ohm version) and specimen 2 (30 ohm version) respectively. The mid-band sound pressures required to give the same output levels are +23 and +26 dB with reference to 0.0002 dyne/cm². The difference between the two figures is thought to be due to production spread; there is no reason to connect it with the difference in impedance. These figures compare favourably with those obtained from valve operated capacitor microphones but are not so low as those given by the Sennheiser type MKH 404 and AKG type CK628 instruments which have radio frequency biasing.

4.2. Interference from Magnetic Fields

Measurements were made of the maximum open-circuit voltage induced in the microphone by a uni-

form magnetic field. The unweighted mid-band sound levels, with reference to 0.0002 dyne/cm², required to give an output equivalent to that produced by a uniform field of 1 milligauss at 50 c/s, 1 kc/s and 10 kc/s are -7 dB, -1 dB and +24 dB respectively. These levels are regarded as extremely low and should cause no trouble under normal studio conditions.

4.3. Wind Noise

Measurements were made of the wind noise generated when two of the microphones were placed at various angles to a streamlined airflow of 10 m.p.h. (16 km/h). To permit comparison with other microphones having a different frequency characteristic at the bass, the measurements were repeated with the microphone electrically equalised to give an axial frequency characteristic uniform within ± 1 dB from 1 kc/s to 40 c/s; below 40 c/s the

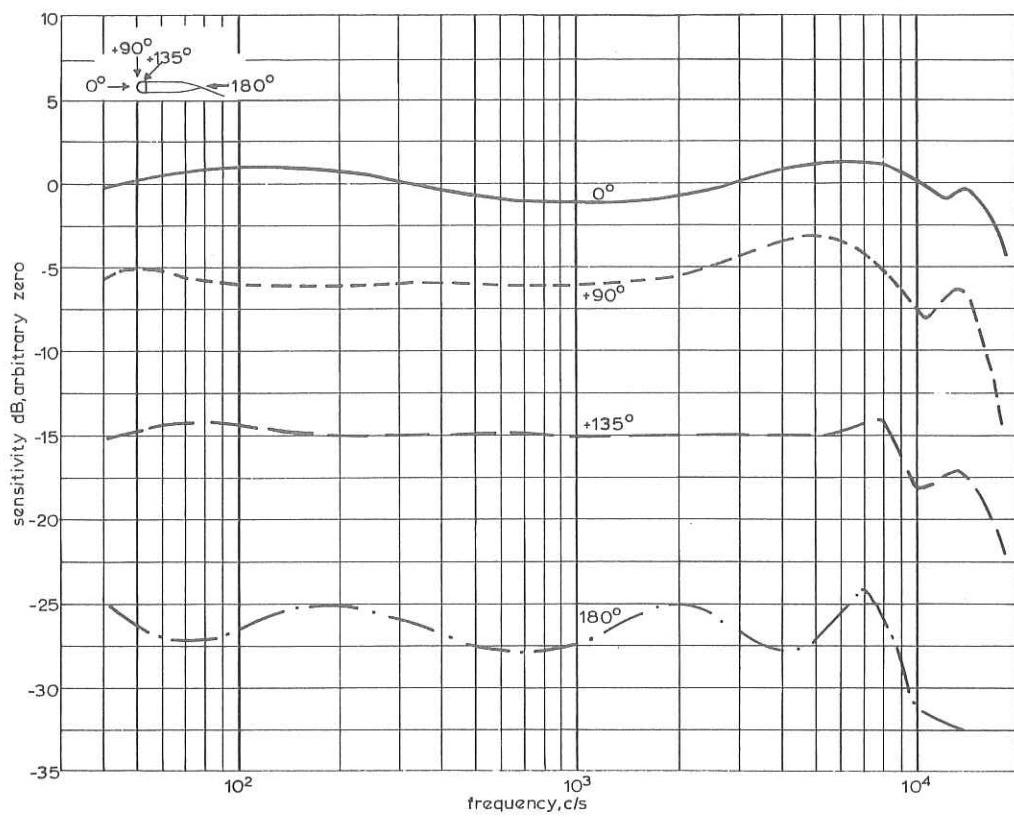


Fig. 6 - Frequency characteristics of S.T. and C. microphone type 4126 replotted from maker's curves

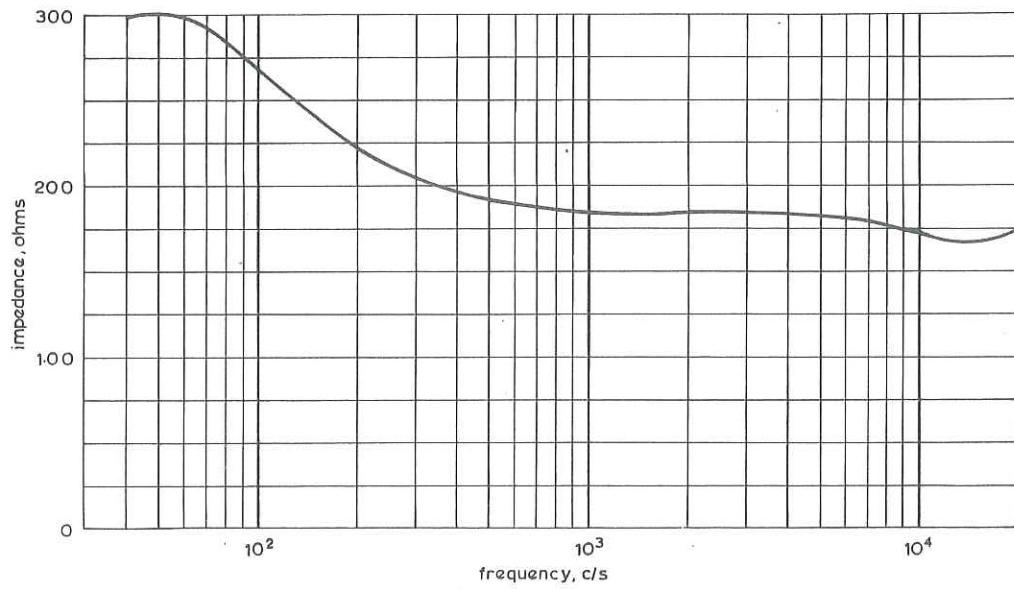


Fig. 7 - Modulus of impedance of S.T. and C. microphone type 4126, specimen 1.
Nominal impedance : 300 ohms

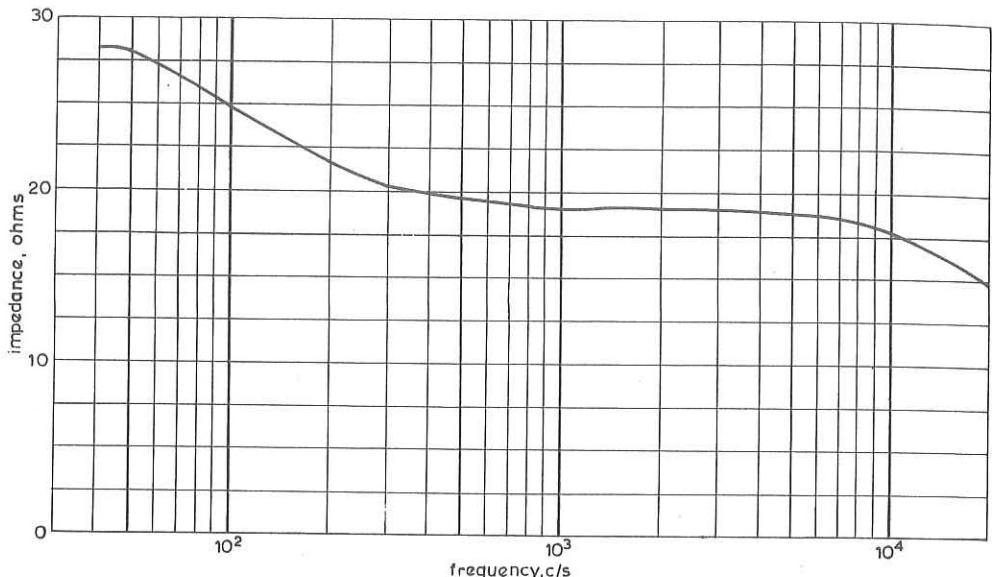


Fig. 8 - Modulus of impedance of S.T. and C. microphone type 4126, specimen 2.
Nominal impedance : 30 ohms

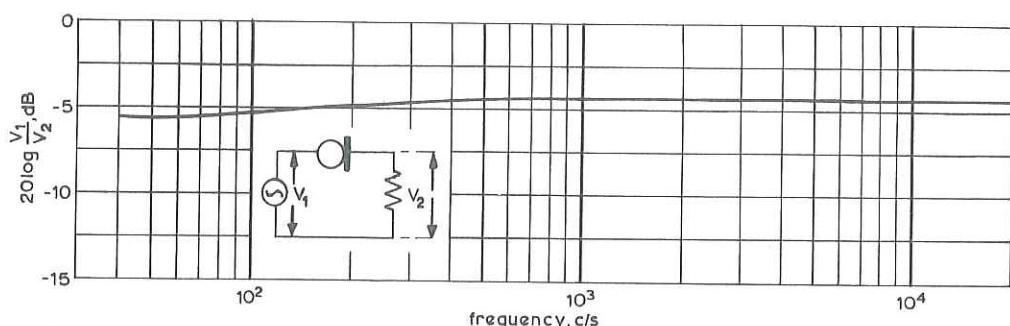


Fig. 9 - S.T. and C. microphone type 4126. Relationship between open-circuit voltage and that developed across a resistive load equal to the nominal impedance

response was attenuated by a high-pass filter. The noise which was measured into open circuit was weighted by the standard A.S.A.* network and measured by a V.U. meter; the results are given in the following table in terms of the level, with respect to 0.0002 dyne/cm², of a 1 kc/s tone calculated to give an equal signal

Once again the difference between the results obtained from the two microphones is thought to be due to spread in production; the values are about the average obtained from capacitor microphones with a cardioid directional characteristic.

4.4. Interpretation of Noise Measurements

In applying these results it should be remembered that aural sensitivity weighting, where used, is intended to give an indication only of the loudness of the noise. The subjective assessment of the annoyance caused depends also on other factors such as the degree to which the interference may blend with the studio "atmosphere" and other background noises.

4.5. Listening Tests

Listening tests were carried out employing speech from "dead" surroundings. The results obtained were in agreement with the objective measurements.

* American Standards Association, Standard Z 24.3 - 1944, "Sound Level Meters for Measurement of Noise and other Sounds".

Fig.

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MICROPHONE CONDITION	ANGLE				
	0°	45°	90°	135°	180°
	dB	dB	dB	dB	dB
Specimen 1 : unequalised	94	85	90	98	95
	equalised	98	88	92	100
Specimen 2 : unequalised	97	90	94	95	92
	equalised	104	99	102	104
					100

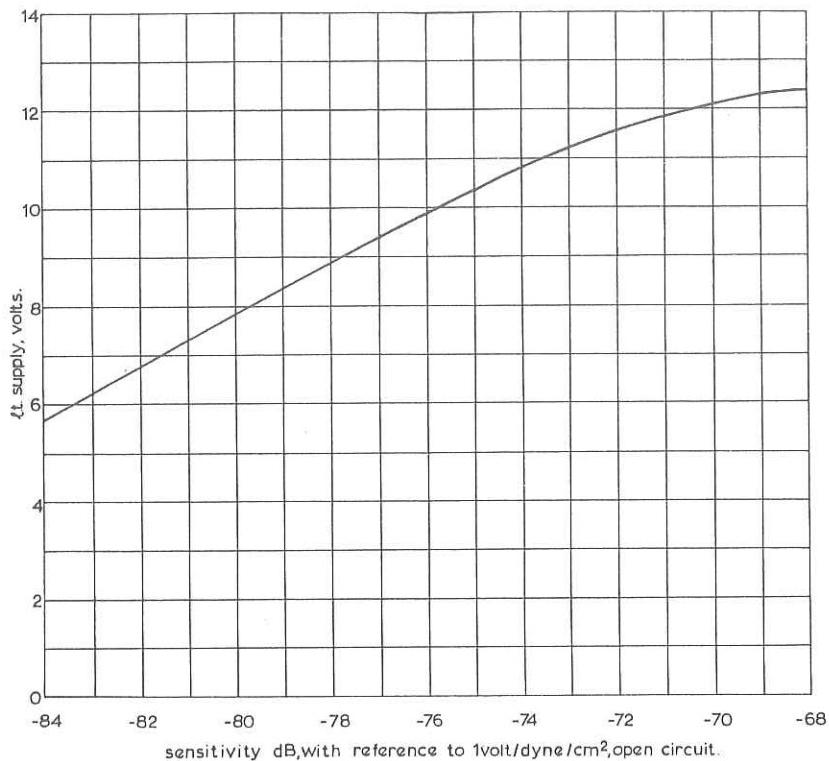


Fig. 10 - S.T. and C. microphone type 4126, specimen 4. Variation of sensitivity with low tension voltage

5. CONCLUSIONS

The use of transistors has enabled the type 4126 microphone to be miniaturised so that it is the smallest capacitor instrument available. The axial response is somewhat deficient at high frequencies and in this respect the microphone performance falls appreciably short of the maker's claims and is inferior to that of the better specimens of the type

4108. In addition, the frequency characteristic for sound incident in the plane at 90° to the axis varies with the direction in that plane. The sensitivity is low compared with that of existing microphones of comparable type and the spread in sensitivity and in bass response amongst the five specimens tested is regarded as excessive. The internally generated noise level is as low as that from the usual valve operated types as is also the interference from wind and magnetic fields.